

## UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO. : 7,114,409  
APPLICATION NO.: 10/790,928  
ISSUE DATE : October 3, 2006  
INVENTOR(S) : Ulrich Eggert, Andreas Hegerath

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column	Line	Error	Correct to Read
1	10	for use in a motor vehicle, and, more particularly, to a short	for use in a motor vehicle, and, more particularly, to short
7	23	when viewed in longitudinal directions of the intermediate	when viewed in either one of the two longitudinal directions of the intermediate
7	29	arid	and
7	40	shaft comprises gears on both intermediate shaft and input	input shaft comprises gears on both intermediate shaft and input

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(12) **United States Patent**  
**Eggert et al.**

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(45) **Date of Patent:** **Oct. 3, 2006**

(54) **SHORT CHANGE GEAR**

(75) Inventors: **Ulrich Eggert**, Viersen (DE); **Andreas Hegerath**, Bergheim (DE)

(73) Assignee: **Getrag Ford Transmissions GmbH**, Cologne (DE)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 5 days.

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(51) **Int. Cl.**  
**F16H 3/08** (2006.01)

(52) **U.S. Cl.** ..... **74/331; 74/339; 74/340**

(58) **Field of Classification Search** ..... **74/331, 74/339, 340**

See application file for complete search history.

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*Primary Examiner*—Saul Rodriguez

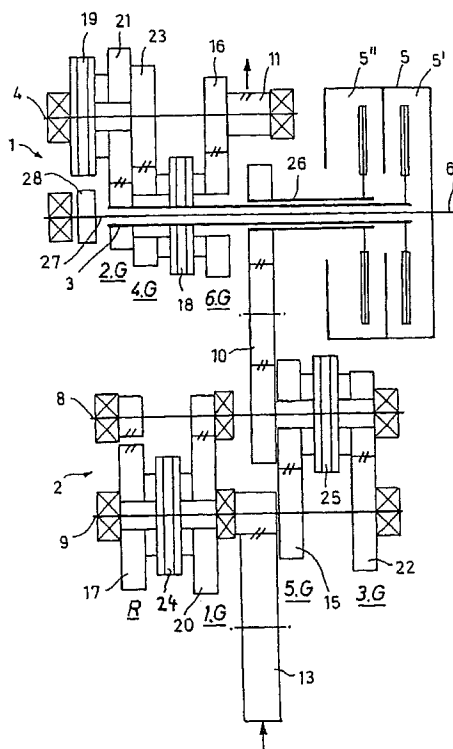
*Assistant Examiner*—David D. Le

(74) *Attorney, Agent, or Firm*—Alexander R. Schlee

(57) **ABSTRACT**

The invention provides a change gear, in particular in motor vehicles. This transmission comprises input and output shafts, a drive shaft that is in torque transmitting connection with the first and second output shafts; a first group of gear sets comprising at least one first gear set; a second group of gear sets comprising at least one second gear set; an intermediate shaft; and a first gear section. The input shaft is connectable with the first output shaft by the first group of gear sets. A second gear section is provided in which the intermediate shaft is connectable to the second output shaft by the second group of gear sets. The intermediate shaft is in gearing connection with the first input shaft.

**17 Claims, 3 Drawing Sheets**



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**SHORT CHANGE GEAR**

Priority from the European Patent Application 03100580.4 is claimed the content of which is herewith incorporated entirely by reference.

**FIELD OF THE INVENTION**

The present invention relates generally to transmissions for use in motor vehicles and, more particularly, to a short change gears.

**BACKGROUND OF THE INVENTION**

A transmission is known from the European Patent EP 1 067 312. This kind of transmission can be configured as manual or automatic change gear or also as a power shift gear. In all of these variations the 2 output shafts are in torque transmitting connection with the drive shaft. In the manual and the automatic gear change version the transmission is provided with an input shaft that is connected by means of several gear sets with the first and with the second output shaft. Each gear set is provided with a fixed gear and a shiftable loose gear. Even though all gear shift mechanisms for shifting the loose wheels are located on the output shafts the interleaved positions of the fixed gears on the input shaft results in a certain overall length of the transmission that is longer than the space needed just for the loose wheels with the gear shift mechanisms. This applies also for the power shift gear version comprising 2 input shafts positioned coaxially to each other and that are likewise interconnected with the output shafts by means of several gear sets.

In the U.S. Pat. No. 6,427,550 a twin-clutch transmission is described comprising one input shaft and one intermediate shaft, said intermediate shaft being connected by means of a chain drive with a transfer shaft coaxially disposed in relation to the input shaft. Input shaft and intermediate shaft are connected by means of several wheel sets with the output shaft. Even though this avoids the problem of interleaved positioning of the various gear sets since the loose wheels on the intermediate shaft and on the input shaft mesh with the same fixed wheels on the output shaft it is a known problem in the prior art that such multiple interdependence between the gear sets renders it difficult to provide the optimum gear speeds in the various gears in relation to each other.

**SUMMARY OF THE INVENTION**

Accordingly, it is an object of the invention to provide a change gear with a very short overall length in lengthwise direction.

It is a further object of the present invention to use the same basic transmission design for different variations such as manual gear shift transmissions, automatic gear shift transmissions, and power gear shift transmissions.

These and other object of the present invention are achieved by a short change gear, in particular for motor vehicles, comprising: at least a first input shaft; a first output shaft; a second output shaft; a drive shaft that is in torque transmitting connection with the first and second output shafts; a first group of gear sets comprising at least one first gear set; a second group of gear sets comprising at least one second gear set; an intermediate shaft; a first gear section in which the input shaft is connectable with the first output shaft by means of the first group of gear sets; a second gear section in which the intermediate shaft is connectable to the

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second output shaft by means of the second group of gear sets; wherein the intermediate shaft is in gearing connection with the first input shaft.

According to this configuration the 2 gear sections are in fact independent transmissions, both of which can be configured as short as possible. Neither an interleaved configuration due to adjacent output shafts, nor mutual interdependence of the gear wheels due to meshing of several loose wheels with the same fixed wheel has to be accepted. The intermediate gear implements a large radial offset between the gear sections in relation to the shafts and does therefore make the second gear section independent from the first.

At the same time, the input shaft can be connected to the first output shaft and the intermediate shaft can be connected to the second output shaft by at least 1 gear set, respectively. For a motor vehicle gear box several gear sets are required depending on how many gears in total the gear box has. Since both gear sections are independent from each other, it is immaterial which gear sets for which gears are provided on which shafts. Any imaginable combination of gear sets can be implemented in the respective gear sections.

The gearing connection between the intermediate shaft and the input shaft can be achieved by any suitable transmission means that allows transmitting both the rotational movement and the torque between the shafts. Particularly, gear wheels on both shafts with an intermediate gear wheel or a chain drive are suitable. For clarity reasons it is referred to the intermediate gear variation in the following but this should be understood as covering also any other suitable transmission means.

An especially space-saving configuration can be achieved if drive pinions on each of the output shafts connecting these output shafts with the respective drive shafts are positioned in the same plane as the intermediate gears. Accordingly, the axial space that has to be provided for the drive pinions in any case can be used at the same time for the intermediate shaft so that no additional axial space is needed for the additional intermediate shaft.

According to another preferred embodiment the second gear section is provided with gear sets being positioned in front of a gear meshing with the intermediate shaft and gear sets are provided behind said meshing gear if viewed in direction of the intermediate shaft. Because of the axial offset of the intermediate shaft in relation to the input shaft the intermediate shaft is also allowed to extend in axial direction towards a clutch and therefore also the space on the level of the clutch is used in a space saving manner.

Preferably, the number of gear sets in the second gear section is at least as high as the number of gear sets in the first gear section. Since due to the measures described in the preceding paragraph the axial space available for the intermediate shaft is bigger than for the input shaft it is advantageous to provide at least the same number of gear sets or better even a higher number of gear sets in the second gear section rather than in the first gear section. The maximum axial length of the entire gear box is determined significantly by the length of the input shaft and therefore by the number of gear sets in the first gear section.

According to a preferred embodiment of the invention the motor shaft can be connected with the input shaft by means of a clutch and the input shaft can be connected with the first output shaft and is connected by means of the intermediate gear with the intermediate shaft. This configuration refers to a manual or an automatic transmission. Such transmissions comprise only one input shaft that is connectable by means of a clutch with the motor shaft of a motor, preferably of a combustion engine. The input shaft is connectable to the first

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an intermediate shaft;

a first gear section in which the first input shaft is connectable with the first output shaft by means of the first group of gear sets;

a second gear section in which the intermediate shaft is connectable to the second output shaft by means of the second group of gear sets;

wherein the intermediate shaft is in gearing connection with the second input shaft.

2. The short change gear of claim 1 further comprising:  
a first drive pinion provided on the first output shaft;  
a second drive pinion provided on the second output shaft;  
wherein the intermediate shaft being in gearing connection with the second input shaft as well as the first and second drive pinions are positioned in one and the same plane.

3. The short change gear of claim 1 wherein the second gear section comprises the second group of gear sets, at least one of these gear sets being positioned in front and at least one of these gear sets being positioned behind the gearing connection of the intermediate shaft to the second input shaft when viewed in longitudinal directions of the intermediate shaft.

either one of the two

4. The short change gear of claim 1 wherein the number of second gear sets in the second gear section is at least as high as the number of first gear sets in the first gear section.

5. The short change gear of claim 1 further comprising:  
loose wheels being part of the first and second gear sets;  
~~and~~ and

mutual synchronizing mechanisms;  
wherein the loose wheels of the gear sets in the gear sections are shifted by means of the mutual synchronizing mechanisms.

6. The short change gear of claim 1 further comprising:  
a pump shaft connected to a motor shaft and provided coaxially and within the first input shaft that is designed as a hollow shaft.

7. The short change gear of claim 1 wherein the gearing connection between the intermediate shaft and the second input shaft comprises gears on both intermediate shaft and input shaft and an intermediate gear.

8. Use of the change gear of claim 1 as a change gear installed in lengthwise orientation in a motor vehicle.

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9. Use of the change gear of claim 1 as a change gear installed in transverse orientation in a motor vehicle.

10. The short change gear of claim 1 further comprising:  
a first clutch;

a second clutch;

wherein a motor shaft is connectable by means of the first clutch with the first input shaft that is connectable with the first output shaft; and

wherein the motor shaft is connectable by means of the second clutch with the second input shaft that is positioned in coaxial relation to the first input shaft, and said second input shaft is connected to the intermediate shaft by means of the gearing connection.

11. The short change gear of claim 10 wherein the first gear section does not comprise any gear sets for even-numbered forward gears and the second gear section does not comprise any gear sets for odd-numbered forward gears.

12. The short change gear of claim 10 wherein the first gear section does not comprise any gear sets for odd-numbered forward gears and the second gear section does not comprise any gear sets for even-numbered forward gears.

13. The short change gear of claim 10 wherein the first gear section comprises the gear sets for the 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> gear, and the second gear section comprises the gear sets for the 1<sup>st</sup>, 3<sup>rd</sup> and 5<sup>th</sup> gear.

14. The short change gear of claim 10 further comprising  
a fixed wheel;

a loose wheel;

an intermediate wheel rotatably borne on a shaft;

wherein the second gear section comprises a gear set for a reverse gear in which the fixed wheel is connected to the loose wheel by means of the intermediate wheel.

15. Use of the change gear of claim 10 as a manual change gear for motor vehicles.

16. Use of the change gear of claim 10 as an automatic change gear for motor vehicles.

17. Use of the change gear of claim 10 as a power shift gear for motor vehicles.

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